Enhancement in Viscosity of Diesel by Using Chemical Additive

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Abstarct--The effects of four different additives for viscosity enhancement of diesel were studied. Two different additive used are namely Ethylene-propylene copolymer, T-818C Copolymer of maleic acid ester, acrylic ester and vinyl acetate, both of these additives were added in different proportion and studies its relative effect on viscosity of base diesel. It is difficult to adjust the small quantity addition of viscosity modifier because of its high viscosity. Hence it was diluted with higher concentration. And then different dilution was made by diluting this mother concentrate. Raise in viscosity of base diesel observed were from 2.6 to 12.8% in case of EPC and 1.95 to 9.76% in case of T-818C Copolymer of maleic acid ester, acrylic ester and vinyl acetate . After each addition of viscosity modifier it s effect on remaining key parameter of diesel were studied.

Keywords- EPC (ethylene-propylene copolymer), viscosity, viscosity index

I. INTRODUCTION

Viscosity of any fluid will decrease as it is heated. Viscosity Index Improvers are used to reduce the thinning effects caused by operation at elevated temperatures. They are the key component that allows for the production of multi-grade oils. These oils reduce the need for oil changes due to changes in ambient temperatures.Typical viscosity index improvers are polymers and copolymers of olefins, methacrylates, dienes or alkylated styrenes. Viscosity Index Improvers are long chain, high molecular weight polymers that function by increasing the relative viscosity of oil more at high temperatures than at low temperatures. Viscosity index improvers can be thought of as springs. They "coil" at cold temperatures and "uncoil" as the temperature increases. Uncoiling makes the molecules larger, which increases internal resistance within the thinning oil. This reduces the overall viscosity loss of the fluid. The long molecules in viscosity index improvers (VII) can be subject to shearing in service, which reduces their ability to minimize fluid viscosity loss. Permanent shear occurs when shear stress ruptures long molecules and converts them into shorter and lower weight molecules. The shortened molecules offer less resistance to flow and minimizes their ability to maintain viscosity. Permanent shearing of viscosity index improvers can result in piston ring sticking (due to deposit formation), increased oil consumption and accelerated equipment wear. It should be noted that some VII's are significantly more shear stable than others. Also, although the type of base stock used and the intended application determines the need for VII, many synthetic stocks may not require them at all. Loss of fluid viscosity can also occur due to a condition known as Temporary Shear. Temporary shear occurs when long viscosity index improver molecules align themselves in the direction of the stress (flow). This alignment generates less resistance and allows for a reduction in fluid viscosity. When the stress is removed, the molecules return to their random arrangement and the temporary loss in viscosity is recovered.

Petroleum diesel observed law value of viscosity then specification. Therefore,it is required to add certain additives called viscosity modifiers (VM; previously known as viscosity index improvers or VII). These are oil soluble polymers, which enable the oil to provide adequate hydrodynamic lubrication at high temperatures and good starting pumping performance at low temperatures. The mechanism of VII operation has been postulated by various researchers, i.e., Selby and Muller. VM improves the viscosity index (VI). This function depends not only on particular polymer chemistry and constitution but also on shear rate and temperature.

II. EXPERIMENT

A. Test of Kinematic Viscosity:

The test was carried out on two different diesel prepared by two different blending stock by same refinery using two different additive formulations (EPC and T818C). Each base oil/additive mixture, known as a pilot blend, was presented in five proportions. The time, T was recorded for a sample of the pilot blend to flow from the upper meniscus of the viscometer tube to the lower meniscus, after the meniscus is sucked up to the upper mark by a compressed air pressure of 6 bar. Each of the base oil/additive mixture proportions is placed in kinematic viscometers maintained at a temperature of 40^0C. The kinematic viscosity (KV) of the oil is a product of the measured time, T and the viscometer tube constant, k, which designates the Onyeji et al. / International Journal of Engineering Science and Technology (IJEST) ISSN : 0975-5462 Vol. 3 No. 3 Mar 2011 1865 friction factor incorporated into the individual tube during manufacture. Therefore kinematic

Viscosity (KV) = K*T

Properties and Applications Ethylene-propylene rubbers & elastomers Oil soluble viscosity index improving ethylene copolymers, such as copolymers of ethylene and propylene; and ethylene, propylene and diolefin; etc., are reacted or grafted with ethylenically unsaturated carboxylic acid moieties, preferably maleic anhydride moieties, and reacted with polyamines having two or more primary amine groups and a C22 to C28 olefin carboxylic acid component, preferably alkylene polyamine and alkenyl succinic anhydride,

respectively. These reactions can permit the incorporation of varnish inhibition and dispersancy into the ethylene copolymer while inhibiting cross-linking with resulting viscosity increase, haze or gelling. The aforesaid grafting reaction may be carried out thermally, or more preferably with a free radical initiator such as a peroxide in a mineral lubricating oil, in which case the olefin carboxylic acid component, preferably also acts to solubilize insoluble compounds formed by side reactions, such as maleic anhydride grafted oil molecules reacted with amine, to thereby inhibit haze formation, particularly when preparing oil concentrates of the V.I.-dispersant additive for later addition to lubricating oils.

Ethylene-propylene copolymer: commercially it is known as Surlyn (Du Pont)

TABLE I.

Appearance	Light yellow Transparent liquid
100°Ckinematic viscosity mm2/s	≥600
Density (20°C) Kg/m3	≥860
Flash point ^{0}C	≥190
Chroma number	≤3.0
Thickening ability mm2/s	≥0.45
SSI Shear Stability Index	≤26

It is difficult to use above additive of viscosity 600 mm2/s directly in to diesel hence we need to prepare its dilution for this we taken 17.0gm of as such additive to 90ml of base diesel dissolve it and makeup it to 100ml by using base diesel this solution is used as mother solution. Prepared several dilutions as shown in bellowing table.

TABLE II.   PROPERTIES OF DIESEL FUEL AND VARIOUS BLENDS OF EPC

Property	Diesel 0%	EPC 0.5%	EPC 1.0%	EPC 5%	EPC 2.0%	EPC 2.5%
Sulphur fraction in the fuel(ppm)	250	245	248	243	240	240
Cetane number	48.0	48.0	48.5	49.0	49.0	50.0
Fuel density (kg/m3)	830.0	834.0	839.0	843	847.5	851.5
Kynemetic viscosity (Cst)	1.946	1.996	2.036	2.096	2.146	2.196

T-818C Copolymer of maleic acid ester, acrylic ester and vinyl acetate:

TABLE III.   SPECIFICATIONS

ITEM	LIMITS
Appearance	Light yellow thicky liquid
Viscosity (100) mm2/s	≥400
Flash point (open)	≥110
Mechanical impurities %	≤0.03
Ash content %	≤0.06
Moisture	Trace
Effective components %	≥60
PPD degree	10-25

In order to add above additive directly to diesel in small quantity is not practically possible because of its high viscosity. So prepared dilute solution of above additive in diesel and added to experimental diesel volumetrically to maintain proportion of 0.5%,1.0%,1.5%,2.0% and 2.5% after addition of this proportion of additive we have tested diesel for key parameter it shows bellowing value.

TABLE IV.   PROPERTIES OF DIESEL FUEL AND VARIOUS BLENDS OF T-818C

Property	T-818C 0%	T-818C 0.5%	T-818C 1.0%	T-818C 1.5%	T-818C 2.0%	T-818C 2.5%
Sulphur fraction in the fuel(ppm)	250	246	247	245	242	242
Cetane number	48.0	48.0	48.3	48.5	48.8	49.4
Fuel density (kg/m3)	830.0	833.8	838.0	840.0	846.9	849.4
Kynemetic viscosity (Cst)	1.946	1.984	2.022	2.066	2.098	2.136

III.   RECOMMENDATION

This work shows that the effect of additives on viscosity of diesel, viscosity of diesel increases as the mass/weight of the additives increases. It is therefore recommended that further work to determine the mass of the additives that will give maximum/ ultimate effect be carried out.

combustion property of diesel is purely depends on its blending materials and additive added to middle distillate as the combustion property changes its burning gas composition also changes hence to understand the property of combustion the gas coming out from exhausted valve of combustion chamber should be analyzed and some more specific effect of additive on diesel fuel can be studied by doing some analytical work on same.

An investigation into the combined effect two or more additives on the base oil is recommended for more studies.

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